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ABSTRACT

An alternative is proposed for the Johnson-Neyman procedure (P. O. Johnson and J. Neyman, 1936). Used when heterogeneous regression lines for two groups are analyzed, the Johnson-Neyman procedure is a technique in which the difference between the two linear regression surfaces for the criterion variate (Y) is estimated conditional on a realization of the predictor variate (X). The motivation of the alternate procedure is to estimate the point on the X variate at which two heterogeneous regression surfaces intersect. An expression of the standard error of the estimate provides, at a given level of alpha, a closed confidence interval for the point of intersection and open regions in the domain of X in which it may be stated with confidence that they do not span the point of intersection. The procedure is illustrated, and its accuracy evaluated through simulation. An advantage of the intersection-point confidence-interval procedure is primarily that it declares significant all differences between estimated regression surfaces that are larger than those in the nonsignificant region, should a significant region exist. Situations under which the Johnson-Neyman procedure is preferable are discussed. (Contains 7 tables and 10 references.) (SLD)

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Intersection Point Confidence Intervals as an Alternative to the Johnson-Neyman Technique

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Paper presented at the American Educational Research Association Convention

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Intersection Point Confidence Intervals as an Alternative to the Johnson-Neyman Technique

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Our purpose is to investigate an alternative to the Johnson-Neyman procedure (Johnson & Neyman, 1936). Used when heterogeneous regression lines for two groups are analyzed, the Johnson-Neyman procedure is a technique in which the difference between the two linear regression surfaces for the criterion variate (Y) is estimated conditional on a realization of the predictor variate (X). Johnson and Neyman found a solution in the domain of X for two boundaries (if they exist) that partition X into ranges in which the difference is (or is not) significant at a given α level. Several researchers have studied and extended the Johnson-Neyman technique; Schafer and Wang (1991) presented a brief review of these investigations and cited several studies in which the Johnson-Neyman technique has been used for substantive research in education and psychology.

The motivation of the alternate procedure is to estimate the point on the X variate at which two heterogeneous regression surfaces intersect. An expression for the standard error of the estimate provides, at a given level of α, a closed confidence interval for the point of intersection and thus open regions in the domain of X in which it may be stated with confidence $(1 - \alpha)$ that they do not span the point of intersection. This approach has an advantage over the Johnson-Neyman procedure in the case where the latter procedure identifies a bounded region of X in which the estimated difference between the regression surfaces is found to be significant. The unbounded regions on either side of the bounded region will thus contain estimated differences between the regression surfaces that are larger than the largest difference in the "significant" region. However, in the alternate procedure, the confidence interval for the point of intersection always contains estimated differences, all of which are smaller than all of those in the region of X where it is estimated the intersection point does not lie. This has some intuitive appeal because larger estimated differences are always more likely to be declared significantly different than smaller differences. Balanced against this advantage is the disadvantage that the alternate procedure is not based on a confidence interval for the conditional difference between the regression surfaces (conditional on a value of X). However, the Johnson-Neyman procedure is based directly on estimating the magnitude of that conditional difference. As with the Johnson-Neyman procedure, of course, regions declared "significant" using the alternate procedure should be interpreted only in relation to the marginal distributions of X in the two groups.

This rationale for the alternate procedure was used by Graybill and Iyer (1994) to motivate the need for a method to identify a confidence interval for the point of intersection of two straight-line regression surfaces. However, although they do not give a source, the procedure they present (Graybill & Iyer, 1994, p. 452) actually is the Johnson-Neyman technique, which they note (Graybill & Iyer, 1994, p. 453) may reach unsatisfactory solutions for the reasons discussed above.

Details of the Alternate Procedure

Let $Y_{ij} = \alpha_j + \beta_j X_{ij} + \epsilon_{ij}$ be the linear regression model for independent groups $j = 1, 2$ and a_j and b_j be least-squares estimates of α_j and β_j, respectively, and let n_j be the sizes of two independent samples from populations 1 and 2. Then the point of intersection of the two linear regression estimates in the population is:

$\frac{\alpha_1 - \alpha_2}{\beta_2 - \beta_1}$ which may be estimated by

$$X_0 = \frac{a_1 - a_2}{b_2 - b_1} \qquad (1)$$

(Graybill and Iyer, 1994, p. 451-2). In (1), the variances and covariances of a_j and b_j are known:

$$\mathrm{Var}(a_j) = \frac{\sigma^2_{\epsilon_j}\,\Sigma_i X_{ij}}{n_j SS_{X_j}}$$

$$\mathrm{Var}\,(b_j) = \frac{\sigma^2_{\epsilon_j}}{SS_{X_j}}$$

$$\mathrm{Cov}\,(a_j,b_j) = \frac{-\overline{X}_j\sigma^2_{\epsilon_j}}{SS_{X_j}}$$

where $\overline{X}_j$ = the mean of X for group j, $\sigma^2_{\epsilon_j}$ is the error variance for population j, and SS_{X_j} is the sum of squares of X for group j (Draper & Smith, 1981, pp. 82-3). Because the groups are independent, $\mathrm{Cov}(a_1,a_2) = \mathrm{Cov}(a_1,b_2) = \mathrm{Cov}(a_2,b_1) = \mathrm{Cov}(b_1,b_2) = 0$.

Formula (1) is a ratio of two random variates of the form $\frac{w_1}{w_2}$, with approximate variance (Kish, 1987, p. 133):

$$\mathrm{Var}\,(\tfrac{w_1}{w_2}) \doteq \tfrac{1}{w_2^2}\left(\mathrm{Var}(w_1) + (\tfrac{w_1}{w_2})^2\,\mathrm{Var}\,(w_2) - 2\,(\tfrac{w_1}{w_2})\,\mathrm{Cov}(w_1,w_2)\right). \qquad (2)$$

Substituting the known variances and covariances into (2) and simplifying yields:

$$\hat{\mathrm{Var}}\,(X_0) = \frac{S_e^2}{(b_2-b_1)^2}\left(\frac{\Sigma_1 X^2}{n_1 SS_{X_1}} + \frac{\Sigma_2 X^2}{n_2 SS_{X_2}} + X_0^2(\tfrac{1}{SS_{X_1}}+\tfrac{1}{SS_{X_2}}) - 2X_0(\tfrac{\overline{X}_1}{SS_{X_1}} + \tfrac{\overline{X}_2}{SS_{X_2}})\right) \qquad (3)$$

in which S_e^2, the pooled error variance estimate for the two groups, has been used for $\sigma^2_{\epsilon_j}$ and, for simplicity, $\Sigma_j X^2 = \Sigma_i X_{ij}^2$ for group j. Then, assuming normality and homoskedasticity of ϵ_{ij}, we use

$$X_0 \pm t_{(n_1+n_2-4,\,\frac{\alpha}{2})}\sqrt{\hat{\mathrm{Var}}\,(X_0)} \qquad (4)$$

where $t_{df,p}$ is the $100*p^{th}$ percentile of the t distribution to identify a $(1-\alpha)$ confidence interval for the abscissa of the point of intersection.

Accuracy of the Alternate Procedure

We have investigated the alternate procedure for α = .05 (.05) .95 where $X \sim N(\mu,36)$, $\beta_1 = 2$, $\beta_2 = -2$, and $\sigma^2_\epsilon = 9$ for all eight combinations of $\mu_{X_1}=\mu_{X_2}=0$, 20, $n_1=n_2=30$, 300, and population point of intersection = 0, 20 with 10,000 replications each. The empirical mean and standard error of the sample point of intersection, the mean estimated standard error, and the theoretical standard error, found by substituting known parameters and expectations of sample statistics based on known parameters into (3), were also calculated. These results and the empirical Type I error rates (rates at which the population point of intersection was outside the associated confidence interval) appear in Table 1.

Insert Table 1 About Here

Encouraged by the findings reported in Table 1, we performed an empirical study of the characteristics of the alternate procedure in relation to the Johnson-Neyman technique and a modified Johnson-Neyman procedure as proposed by Potthoff (1964). The latter two approaches were compared on Type I error rate by Chou and Huberty (1992) for two configurations of population regression parameters (equal slopes and intercepts, and heterogeneous slopes) and three additional factors: conditional distribution shape, conditional

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variance ratio, and sample size ratio. Because these are very well-known techniques, their details are omitted; Chou and Huberty (1992) provide motivations and formulas for both and give several references.

Our current study replicates Chou and Huberty's (1992) conditions, adding the alternate procedure as a third approach. We also evaluated cases in which the X coordinate of the population point of intersection is outside the 99% high-density regions of the X distributions as well as the condition in which the point of intersection is at the equal means of X for the two groups (the condition studied by Chou & Huberty). As suggested by Chou and Huberty (1992) and studied by Chou and Wang (1992), we also included a "protected" version of these three procedures, in which a homogeneity of regression test is used as a precondition; if the homogeneity of regression test results in rejection, the above procedures are applied, but if the homogeneity of regression test does not result in rejection, the differences between the regression surfaces are compared using the usual test for homogeneity of intercepts. Thus, there were three configurations of slopes and intercepts and six procedures studied.

Simulation Procedures

Arbitrarily, the distribution of X was N(20,9) for each of two groups. These parameters imply that the interval from X_1=10 to X_2=30 ($z_1=-3.\overline{3}$ to $z_2=+3.\overline{3}$) is expected to contain over 99.9% of randomly sampled realizations of X. In each simulated experiment, n_1 and n_2 realizations of X were randomly sampled to form two groups and, for each X_{ij}, where i = case and j = group, Y_{ij} was formed according to: $Y_{i1}= \alpha_1 + \beta_1 X_{i1}+ \epsilon_{i1}$ for group 1 and $Y_{i2}= \alpha_2 + \beta_2 X_{i2}+ \epsilon_{i2}$ for group 2, where ϵ_{ij} was randomly sampled from $\phi(0,\sigma_j^2)$. This follows exactly the procedures used by Chou and Huberty (1992).

Three conditions were manipulated: (1) sample size at four levels; (n_1,n_2) = (25,25), (75,75), (17,47), (60,100); (2) conditional Y (i.e., expected ϵ_{ij}) variances at three levels; $(\sigma^2_{\epsilon_{i1}}, \sigma^2_{\epsilon_{i2}})$ = (18,54), (36,36), (54,18); (3) conditional Y distribution shape (i.e., ϕ) at eight levels; (skewness, kurtosis, description) = (0, −1, platykurtic), (.75, 0, moderately skewed), (0, 1, slightly leptokurtic), (0, 3.75, moderately leptokurtic), (.5, 3.75, slightly skewed and moderately leptokurtic), (1, 3.75, moderately skewed and moderately leptokurtic), (1.75, 3.75, highly skewed and moderately leptokurtic), (0, 0, normal).

The sample sizes were manipulated to represent two conditions of equality, large and small, and two conditions of inequality, large and small, chosen so that their harmonic mean was equal to the corresponding size for the equality condition. This differs from the conditions studied by Chou and Huberty (1992); they manipulated equal sample sizes at three levels: (10,10), (20,20), (30,30) and unequal sample sizes at two levels: (10,20), (10,30).

The conditional Y variances and the conditional Y distribution shapes were identical to those used by Chou and Huberty (1992). They chose the variances to set the average at 36 for each condition and the distribution shapes to follow those used by Olejnik and Algina (1987) in a study of Type I error rates and power of the analysis of covariance under heteroscedastic conditions. As in both these studies, they were manipulated using the procedure developed by Fleishman (1978).

The values of α_1, α_2, β_1 and β_2 were chosen to construct three configurations. In configuration (1), $\alpha_1 = \alpha_2 = 0$ and $\beta_1 = \beta_2 = 2$ formed two collinear regressions. In configuration (2), $\alpha_1 = 40$, $\alpha_2 = -40$, $\beta_1 = -2$, $\beta_2 = 2$ formed two regressions intersecting at X = 20, the mean of each of the two groups. In configuration (3), $\alpha_1 = 20$, $\alpha_2 = -20$, $\beta_1 = -2$, $\beta_2 = 2$ formed two regressions intersecting at X = 10, an uncommon value in each of the two groups. These three configurations were studied separately.

Each condition was studied with 3,000 replications. For each replication, six procedures were applied: the Johnson-Neyman procedure (Johnson & Neyman, 1936), the modified Johnson-Neyman procedure (Potthoff, 1964), and the intersection point confidence interval procedure, each with and without protection. In the protected version, if the hypothesis of homogeneity of regression surfaces was retained, the test for homogeneity of intercepts conditional on homogeneity of slopes was applied instead of any of the three procedures. It should

be noted that protected versions of the three procedures may be either more or less conservative (or powerful) than the unprotected versions since a significant region may be found for the intercepts test.

In configuration one, the outcome variable studied was existence of any region of significance. If any region existed, the outcome was considered a Type I error since condition one consists of two collinear surfaces.

Two outcome variables were retained for each replication in configurations two and three. If a region of significance existed and contained the point of intersection (X = 20 in configuration two or X = 10 in configuration three), the outcome was considered a Type I error [this event was called a Type III error by Chou & Huberty (1992)]. The other variable was the size of the region between X = 10 and X = 30 within which significant differences were declared. This variable ranges from zero to twenty and can be interpreted as an analog for power. In the protected version, if the test for homogeneity of intercepts was reached, the size of the region was either zero if nonsignificance was observed, or twenty if significance was observed.

All simulations were performed on a desktop computer using the Gauss programming language. When conditions were identical, consistency with the results of Chou and Huberty (1992) was evaluated as a check on our implementation (all results were comparable). Analyses of outcome variables were performed using SPSS on a mainframe computer. The authors are grateful to the University of Maryland Computer Science Center for providing mainframe support for this project.

Results are organized by configuration. Type I error rates were estimated at the $\alpha = .05$ level of significance. Assuming a theoretical Type I error rate of .05, the standard error of an observed Type I error rate for n = 3,000 is .004. Thus, differences of .01 or greater between rates may be interpreted. Differences among region sizes were evaluated using multivariate analysis of variance for the within-subjects design.

Results

In configuration one, only Type I error rate was studied. Table 2 presents the observed Type I error rates for each cell in the simulation study.

Insert Table 2 About Here

For the conditions studied by Chou and Huberty (1992), our results for the unprotected Johnson-Neyman technique (Johnson & Neyman, 1936) and the unprotected modified Johnson-Neyman technique (Potthoff, 1964) appear not to be interpretably different from theirs. Interestingly, while the protected Johnson-Neyman technique appears more conservative than the unprotected Johnson-Neyman technique, the reverse appears true for the modified Johnson-Neyman technique. The Type I error rates for the unprotected intersection point confidence interval procedure were near 50% but for the protected version were virtually equivalent to the protected Johnson-Neyman Type I error rates. As expected on theoretical grounds (see Potthoff, 1964), the unprotected modified Johnson-Neyman technique provided Type I error rates closest to nominal. All techniques were notably liberal when larger sample sizes were associated with smaller conditional variances if these factors were unequal and were relatively unaffected by distribution shape. These findings are consistent with those of Chou and Huberty (1992).

Both Type I error rate and region size were studied for configurations two and three (linear regressions with heterogeneous slopes). The observed Type I error rates for configuration two (centered intersection point) are presented in Table 3. In this configuration, the population point of intersection was at the mean of the two populations on X. A Type I error was declared if a region of significance contained the point of intersection.

Insert Table 3 About Here

The Type I error rates of the protected and unprotected versions of each of the three procedures were virtually identical. Consistent with the findings of Chou and Huberty (1993), the modified Johnson-Neyman

technique was conservative and the original Johnson-Neyman technique was near its nominal value of .05. The intersection point confidence interval procedure also yielded Type I error rates comparable with the nominal value. Parallel results to those for configuration one were observed for conditional variances, sample sizes, and distribution shapes.

The multivariate analysis of variance on region size for configuration two provided a significant four-way interaction (Wilks's $F = 18.187$, $df = 84, 575806$, $p < .001$) between sample size configuration, conditional variance ratio, distribution shape, and method of analysis. Therefore, results are presented disaggregated for these factors and appear in Table 4.

Insert Table 4 About Here

In general, the intersection-point confidence-interval procedure yielded the larger significant regions, followed by the original Johnson-Neyman procedure. Differences in region size between these two procedures were slight. The smaller significant regions, as expected, were obtained from the modified Johnson-Neyman procedure. Virtually no differences were observed between the protected and unprotected versions of each of the three procedures. Across all conditions in the simulations, the average region sizes were 18.56 for the unprotected intersection-point confidence-interval procedure, 18.55 for the protected intersection-point confidence-interval procedure, 18.45 for both unprotected and protected original Johnson-Neyman techniques, and 17.96 for both unprotected and protected modified Johnson-Neyman techniques.

Type I error rates for configuration three (noncentered intersection point) are presented in Table 5. In this configuration, the population point of intersection was fixed at $X = 10$.

Insert Table 5 About Here

Again, the Type I error rates for the unprotected and protected versions of each of the three techniques were comparable. In general, the Type I error rates for the intersection-point confidence-interval procedure were not interpretably different from those of the original Johnson-Neyman procedure and neither was interpretably different from the nominal rate of .05. The Type I error rates for the modified Johnson-Neyman procedure were interpretably smaller than nominal.

As with configuration two, the multivariate analysis of region sizes for configuration three (noncentered intersection point) yielded a significant four-way interaction (Wilks's $F = 10.706$, $df = 84, 575806$, $p < .001$) between sample size configuration, conditional variance ratio, distribution shape, and method of analysis. Therefore, results are presented disaggregated for these factors and appear in Table 6.

Insert Table 6 About Here

The results for configuration three are noticeably different from those of configuration two. In configuration two, the intersection-point confidence-interval procedure yielded the larger regions of significance, but in configuration three, the regions of significance were generally larger for both the original and modified Johnson-Neyman techniques than for the intersection-point confidence-interval procedures. Over all conditions studied, the average significant interval sizes were 18.12 for both the unprotected and protected original Johnson-Neyman technique, 17.73 for the protected modified Johnson-Neyman technique, 17.72 for the unprotected original Johnson-Neyman technique, 17.59 for the protected intersection-point confidence-interval procedure, and 17.56 for the unprotected intersection-point confidence-interval procedure.

Discussion

In the case of collinear regression surfaces, only the unprotected modified Johnson-Neyman technique yielded Type I error rates close to nominal. The common sequential procedures studied here as protected versions of each of the Johnson-Neyman procedures yielded, in general, smaller Type I error rates for the

original Johnson-Neyman procedure and slightly larger Type I error rates for the modified Johnson-Neyman procedure. The Type I error rates for the protected intersection-point confidence-interval procedure were comparable with those of the protected original Johnson-Neyman procedure. The Type I error rates for the unprotected intersection-point confidence-interval procedure were unacceptably large, but the population in the case of collinear regression surfaces contains more than one intersection point. Such a configuration implies that an estimated point of intersection is accurate no matter where it is located. It would be interesting to study the location of the regions of significance identified by the intersection-point confidence-interval procedure for collinear regression surfaces to observe whether they tend to be found in dense or sparse regions of the covariate (X).

An advantage of the intersection-point confidence-interval procedure is primarily that it declares significant all differences between estimated regression surfaces that are larger than those in the nonsignificant region, should a significant region exist. It also yields larger regions for populations in which the intersection point is at (or near) the means of the groups. In such a population, the interaction between groups and covariate (X) is disordinal, and perhaps, therefore, of more interest to researchers than populations such as our configuration three, in which the intersection point is outside the most common region of the covariate. However, for configuration three, the significant region size was smallest for the intersection-point confidence-interval procedure. This result suggests that researchers who suspect an ordinal interaction would be better advised to choose the Johnson-Neyman procedure for analysis.

In an effort to explore the behavior of the unprotected intersection-point confidence-interval procedure further in cases such as configuration three, in which the population point of intersection is in a sparse region of the covariate (X), we conducted a series of simulations in which all conditions were as in configuration three with the exceptions that the slopes were varied from $\pm.1$ to $\pm.7$ by $\pm.2$ for the two groups and intercepts were chosen to fix the population point of intersection at $X=10$. Sample sizes were 25, 75, 150, 250, 500, 1000, and 2000. Only normal conditional error distributions were studied and each combination was studied with 1000 replications. We observed the Type I error rate at the $\alpha=.05$ level, and compared the theoretical and average estimated standard errors with the observed standard error for each combination. It should be noted that the variance of the estimated intersection point [formula (3)] contains the difference between the slopes in the denominator, and thus conditions in which the slopes are similar may prove difficult for the intersection-point confidence-interval procedure (approaching our configuration one, in which collinear regression surfaces were studied). Results appear in Table 7.

Insert Table 7 About Here

For small absolute values of slopes and for small sample sizes, the intersection-point confidence interval technique appears too liberal and formula (3) yields standard errors that are too small when expectations are used as substitutions and too large when used with sample data. When slopes were $\pm.1$, even with sample sizes set at 2,000, unacceptable results were found. For slopes of $\pm.3$ and $\pm.5$, acceptable results appear to occur for sample sizes of 500 or more. For slopes of $\pm.7$, sample sizes of at least 250 seem to be sufficient to yield reasonably useful results.

With differences in slopes on the order of about $\pm.3$ or more and relatively large sample sizes (at least 500 in each group), the intersection-point confidence interval approach seems at least tentatively to be a viable alternative to the Johnson-Neyman technique, particularly when disordinal interactions are expected. But routine application of the intersection-point confidence interval technique seems inappropriate. Estimation becomes problematic when slopes are similar and the protected original Johnson-Neyman technique provided reasonably acceptable results across all three configurations we studied.

Two directions for further research would appear to be helpful. First, a way to estimate the standard error of an intersection point that is resistant to small sample sizes and near-parallel regression surfaces would be helpful. Second, more sensitive region size comparisons would result from studying conditions with less

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power, such as by increasing the conditional error variance or decreasing the sample sizes from those used in this study.

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Table 1. Empirical Type I Error Rates for 10,000 Replications, Mean Points of Intersection, Standard Errors, and Theoretical Standard Errors for Selected Type I Error Rates, Parameters and Sample Sizes.

	n_j=	30	30	30	30	300	300	300	300
	Int=	0	0	20	20	0	0	20	20
α	μ_X=	0	20	0	20	0	20	0	20
.05		.0427	.0515	.0491	.0404	.0487	.0509	.0505	.0506
.10		.0948	.0856	.0876	.0916	.0974	.1016	.0987	.1047
.15		.1466	.1277	.1325	.1452	.1479	.1537	.1492	.1554
.20		.1967	.1764	.1772	.1966	.1986	.2018	.2010	.2039
.25		.2473	.2277	.2248	.2473	.2492	.2501	.2517	.2515
.30		.2950	.2783	.2774	.3006	.3021	.2986	.3030	.2990
.35		.3432	.3281	.3337	.3506	.3490	.3486	.3532	.3466
.40		.3939	.3805	.3856	.4012	.4007	.3978	.4021	.3963
.45		.4479	.4326	.4374	.4550	.4537	.4488	.4498	.4419
.50		.4992	.4688	.4889	.4984	.5022	.4978	.4982	.4962
.55		.5497	.5373	.5411	.5472	.5540	.5495	.5480	.5498
.60		.6007	.5901	.5919	.5969	.6034	.6009	.6001	.6024
.65		.6530	.6407	.6454	.6461	.6548	.6486	.6537	.6500
.70		.7058	.6931	.6923	.6963	.7042	.6973	.7049	.6999
.75		.7565	.7446	.7448	.7482	.7551	.7463	.7550	.7498
.80		.8043	.7969	.7950	.7994	.8051	.7963	.8037	.8032
.85		.8545	.8492	.8477	.8506	.8516	.8461	.8550	.8515
.90		.9023	.9025	.8984	.9036	.9012	.8991	.9009	.9017
.95		.9539	.9496	.9465	.9532	.9500	.9485	.9485	.9527
Mean Int:		.0043	-.4009	20.4382	19.9975	-.0006	-.0345	20.0318	20.0004
SE(Int):		.4106	2.9556	2.9917	.4095	.1230	.8380	.8358	.1239
Mean Est. SE:		.4113	3.0619	3.0798	.4122	.1233	.8368	.8366	.1233
Theor. SE:		.3939	2.6555	2.6555	.3939	.1227	.8270	.8270	.1227

Notes:

1. n_j is the size of each of the two groups
2. Int is the population point of intersection
3. μ_X is the mean of X for each of the two groups
4. α is the theoretical Type I error rate (used to obtain the percentiles of t)
5. Mean Int is the mean of the 10,000 observed sample points of intersection (X_0)
6. SE(Int) is the standard deviation of the 10,000 observed sample points of intersection
7. Mean Est. SE is the average of the 10,000 standard errors of X_0, each computed by the proposed formula: formula (3)
8. Theor. SE is the standard error of X_0 based on parameters and expectations of sample statistics substituted into the proposed formula: formula (3)

Table 2. Type I Error Rates for Collinear Regression Surfaces

Conditions				Procedure					
Samples	Variances	Error Distribution		Unprot.	Unprot.	Unprot.	Protected	Protected	Protected
N1:N2	V1:V2	Skew	Kurt.	Johnson Neyman	Potthoff J - N	Intersec. Pt. C. I.	Johnson Neyman	Potthoff J - N	Intersec. Pt. C. I.
25:25	18:54	0.000	-1.000	0.15	0.06	0.51	0.10	0.08	0.10
		0.750	0.000	0.14	0.05	0.51	0.08	0.07	0.09
		0.000	1.000	0.14	0.05	0.50	0.10	0.08	0.10
		0.000	3.750	0.15	0.05	0.50	0.10	0.08	0.10
		0.500	3.750	0.15	0.05	0.48	0.10	0.07	0.10
		1.000	3.750	0.15	0.06	0.51	0.11	0.08	0.11
		1.750	3.750	0.15	0.05	0.50	0.10	0.08	0.10
		0.000	0.000	0.14	0.05	0.50	0.10	0.07	0.10
	36:36	0.000	-1.000	0.15	0.06	0.51	0.11	0.08	0.11
		0.750	0.000	0.15	0.06	0.52	0.11	0.08	0.11
		0.000	1.000	0.14	0.05	0.52	0.10	0.08	0.11
		0.000	3.750	0.15	0.06	0.48	0.11	0.08	0.11
		0.500	3.750	0.15	0.06	0.49	0.10	0.08	0.10
		1.000	3.750	0.15	0.05	0.52	0.10	0.07	0.10
		1.750	3.750	0.17	0.08	0.51	0.12	0.08	0.12
		0.000	0.000	0.16	0.07	0.50	0.11	0.09	0.11
	54:18	0.000	-1.000	0.16	0.06	0.50	0.11	0.08	0.11
		0.750	0.000	0.13	0.05	0.52	0.09	0.07	0.09
		0.000	1.000	0.14	0.05	0.50	0.10	0.07	0.10
		0.000	3.750	0.15	0.05	0.50	0.10	0.08	0.11
		0.500	3.750	0.16	0.07	0.50	0.11	0.09	0.11
		1.000	3.750	0.15	0.06	0.50	0.11	0.08	0.11
		1.750	3.750	0.14	0.04	0.48	0.09	0.07	0.10
		0.000	0.000	0.15	0.06	0.50	0.10	0.08	0.10
75:75	18:54	0.000	-1.000	0.16	0.06	0.51	0.11	0.08	0.11
		0.750	0.000	0.15	0.05	0.49	0.11	0.08	0.11
		0.000	1.000	0.15	0.04	0.49	0.10	0.07	0.10
		0.000	3.750	0.19	0.07	0.49	0.13	0.10	0.13
		0.500	3.750	0.18	0.07	0.50	0.13	0.10	0.13
		1.000	3.750	0.16	0.06	0.50	0.11	0.08	0.11
		1.750	3.750	0.17	0.06	0.51	0.11	0.09	0.11
		0.000	0.000	0.15	0.05	0.50	0.10	0.08	0.10
	36:36	0.000	-1.000	0.19	0.07	0.47	0.13	0.11	0.13
		0.750	0.000	0.16	0.06	0.49	0.11	0.08	0.11
		0.000	1.000	0.15	0.06	0.51	0.11	0.09	0.11
		0.000	3.750	0.21	0.08	0.50	0.15	0.12	0.15
		0.500	3.750	0.22	0.09	0.51	0.15	0.12	0.15
		1.000	3.750	0.17	0.06	0.48	0.12	0.09	0.12
		1.750	3.750	0.17	0.07	0.50	0.12	0.09	0.12
		0.000	0.000	0.17	0.06	0.51	0.11	0.08	0.11
	54:18	0.000	-1.000	0.16	0.06	0.51	0.10	0.08	0.10
		0.750	0.000	0.14	0.04	0.51	0.09	0.07	0.09
		0.000	1.000	0.15	0.05	0.50	0.11	0.08	0.11
		0.000	3.750	0.16	0.06	0.50	0.11	0.08	0.11
		0.500	3.750	0.18	0.07	0.50	0.13	0.10	0.13
		1.000	3.750	0.15	0.06	0.49	0.10	0.08	0.10
		1.750	3.750	0.14	0.04	0.49	0.09	0.07	0.09
		0.000	0.000	0.14	0.05	0.51	0.10	0.07	0.10

Table 2 continued Type I Error Rates for Collinear Regression Surfaces

Samples	Conditions Variances	Error Distribution		Procedure Unprot. Johnson	Unprot. Potthoff	Unprot. Intersec.	Protected Johnson	Protected Potthoff	Protected Intersec.
N1 N2	V1 V2	Skew	Kurt	Neyman	J - N	Pt. C. I.	Neyman	J - N	Pt. C. I.
17 47	18 54	0.000	-1.000	0.10	0.03	0.47	0.06	0.05	0.06
		0.750	0.000	0.12	0.04	0.49	0.08	0.06	0.08
		0.000	1.000	0.18	0.07	0.52	0.13	0.10	0.13
		0.000	3.750	0.23	0.11	0.54	0.18	0.14	0.18
		0.500	3.750	0.20	0.09	0.53	0.15	0.12	0.15
		1.000	3.750	0.21	0.08	0.54	0.15	0.11	0.15
		1.750	3.750	0.13	0.05	0.49	0.08	0.07	0.08
		0.000	0.000	0.13	0.05	0.47	0.09	0.07	0.09
	36 36	0.000	-1.000	0.03	0.00	0.37	0.02	0.01	0.02
		0.750	0.000	0.04	0.01	0.39	0.02	0.02	0.02
		0.000	1.000	0.06	0.01	0.43	0.04	0.02	0.04
		0.000	3.750	0.09	0.02	0.44	0.06	0.04	0.06
		0.500	3.750	0.08	0.03	0.44	0.05	0.04	0.05
		1.000	3.750	0.07	0.02	0.44	0.05	0.04	0.05
		1.750	3.750	0.06	0.02	0.41	0.04	0.03	0.04
		0.000	0.000	0.06	0.02	0.42	0.04	0.03	0.04
	54 18	0.000	-1.000	0.26	0.13	0.55	0.20	0.16	0.20
		0.750	0.000	0.27	0.13	0.58	0.21	0.17	0.21
		0.000	1.000	0.33	0.18	0.60	0.25	0.21	0.25
		0.000	3.750	0.37	0.22	0.61	0.30	0.25	0.30
		0.500	3.750	0.37	0.22	0.61	0.30	0.26	0.30
		1.000	3.750	0.35	0.20	0.59	0.27	0.23	0.27
		1.750	3.750	0.28	0.14	0.57	0.22	0.18	0.22
		0.000	0.000	0.30	0.15	0.55	0.23	0.19	0.23
60 100	18 53	0.000	-1.000	0.14	0.04	0.48	0.10	0.06	0.10
		0.750	0.000	0.14	0.05	0.51	0.09	0.07	0.09
		0.000	1.000	0.17	0.06	0.51	0.11	0.09	0.12
		0.000	3.750	0.22	0.10	0.51	0.17	0.14	0.17
		0.500	3.750	0.22	0.10	0.50	0.16	0.13	0.16
		1.000	3.750	0.19	0.07	0.51	0.14	0.11	0.14
		1.750	3.750	0.15	0.05	0.48	0.10	0.08	0.10
		0.000	0.000	0.14	0.05	0.50	0.09	0.07	0.09
	36 36	0.000	-1.000	0.09	0.03	0.43	0.06	0.05	0.06
		0.750	0.000	0.10	0.03	0.46	0.06	0.05	0.06
		0.000	1.000	0.09	0.03	0.47	0.06	0.05	0.06
		0.000	3.750	0.16	0.06	0.46	0.11	0.10	0.11
		0.500	3.750	0.16	0.05	0.45	0.10	0.09	0.10
		1.000	3.750	0.12	0.04	0.46	0.08	0.06	0.08
		1.750	3.750	0.10	0.03	0.46	0.07	0.05	0.07
		0.000	0.000	0.09	0.03	0.45	0.06	0.04	0.06
	54 18	0.000	-1.000	0.21	0.10	0.54	0.16	0.13	0.16
		0.750	0.000	0.22	0.09	0.54	0.16	0.13	0.16
		0.000	1.000	0.25	0.12	0.57	0.18	0.14	0.18
		0.000	3.750	0.29	0.14	0.57	0.22	0.18	0.22
		0.500	3.750	0.25	0.12	0.53	0.19	0.16	0.20
		1.000	3.750	0.25	0.12	0.54	0.19	0.15	0.19
		1.750	3.750	0.22	0.10	0.53	0.15	0.13	0.16
		0.000	0.000	0.22	0.10	0.54	0.16	0.13	0.16

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Table 3 Type I Error Rates for Centered Intersection Point

Conditions				Procedure					
Samples	Variances	Distribution Shape		Unprot. Johnson	Unprot. Potthoff	Unprot. Intersec.	Protected Johnson	Protected Potthoff	Protected Intersec.
N1 N2	V1 V2	Skew	Kurt	Neyman	J-N	Pt. C. I.	Neyman	J-N	Pt. C. I.
25,25	18,54	0.000	-1.000	.06	.02	.04	.06	.02	.04
		0.750	0.000	.05	.01	.04	.05	.01	.04
		0.000	1.000	.05	.01	.04	.05	.01	.04
		0.000	3.750	.06	.02	.05	.06	.02	.05
		0.500	3.750	.05	.02	.04	.05	.02	.04
		1.000	3.750	.07	.02	.05	.07	.02	.05
		1.750	3.750	.05	.01	.04	.05	.01	.04
		0.000	0.000	.05	.01	.03	.05	.01	.03
	36,36	0.000	-1.000	.06	.02	.04	.06	.02	.04
		0.750	0.000	.06	.02	.05	.06	.02	.05
		0.000	1.000	.05	.02	.04	.05	.02	.04
		0.000	3.750	.07	.02	.06	.07	.02	.06
		0.500	3.750	.06	.02	.05	.06	.02	.05
		1.000	3.750	.05	.02	.04	.05	.02	.04
		1.750	3.750	.07	.02	.06	.07	.02	.06
		0.000	0.000	.06	.02	.05	.06	.02	.05
	54,18	0.000	-1.000	.07	.02	.05	.07	.02	.05
		0.750	0.000	.06	.02	.04	.06	.02	.04
		0.000	1.000	.05	.02	.05	.05	.02	.05
		0.000	3.750	.05	.02	.04	.05	.02	.04
		0.500	3.750	.05	.01	.05	.05	.01	.05
		1.000	3.750	.05	.02	.04	.05	.02	.04
		1.750	3.750	.05	.01	.04	.05	.01	.04
		0.000	0.000	.07	.02	.04	.07	.02	.05
75,75	18,54	0.000	-1.000	.06	.02	.06	.06	.02	.06
		0.750	0.000	.07	.02	.06	.07	.02	.06
		0.000	1.000	.06	.02	.05	.06	.02	.05
		0.000	3.750	.08	.03	.08	.08	.03	.08
		0.500	3.750	.09	.03	.08	.09	.03	.08
		1.000	3.750	.07	.02	.07	.07	.02	.07
		1.750	3.750	.06	.02	.06	.06	.02	.06
		0.000	0.000	.05	.01	.04	.05	.01	.04
	36,36	0.000	-1.000	.08	.03	.07	.08	.03	.07
		0.750	0.000	.08	.03	.08	.08	.03	.08
		0.000	1.000	.06	.02	.06	.06	.02	.06
		0.000	3.750	.11	.04	.11	.11	.04	.11
		0.500	3.750	.09	.03	.09	.09	.03	.09
		1.000	3.750	.07	.03	.07	.07	.03	.07
		1.750	3.750	.08	.03	.07	.08	.03	.07
		0.000	0.000	.06	.02	.05	.06	.02	.05
	54,18	0.000	-1.000	.07	.03	.06	.07	.03	.06
		0.750	0.000	.05	.02	.05	.05	.02	.05
		0.000	1.000	.06	.02	.05	.06	.02	.05
		0.000	3.750	.07	.02	.06	.07	.02	.06
		0.500	3.750	.07	.02	.06	.07	.02	.06
		1.000	3.750	.07	.02	.07	.07	.02	.07
		1.750	3.750	.06	.02	.06	.06	.02	.06
		0.000	0.000	.06	.02	.05	.06	.02	.05

Table 3 continued Type I Error Rates for Centered Intersection Point

Conditions				Procedure					
Samples	Variances	Distribution Shape		Unprot. Johnson	Unprot. Potthoff	Unprot. Intersec.	Protected Johnson	Protected Potthoff	Protected Intersec.
N1 N2	V1 V2	Skew	Kurt	Neyman	J-N	Pt. C. I.	Neyman	J-N	Pt. C. I.
17:47	18 54	0.000	-1.000	04	01	03	04	01	03
		0.750	0.000	04	01	03	04	01	03
		0.000	1.000	06	02	05	06	02	05
		0.000	3.750	10	04	09	10	04	09
		0.500	3.750	09	03	08	09	03	08
		1.000	3.750	07	02	06	07	02	06
		1.750	3.750	04	01	03	04	01	03
		0.000	0.000	04	01	03	05	02	03
	36 36	0.000	-1.000	01	00	01	01	00	01
		0.750	0.000	02	00	01	02	00	01
		0.000	1.000	01	00	01	01	00	01
		0.000	3.750	04	01	03	04	01	03
		0.500	3.750	03	01	02	03	01	02
		1.000	3.750	02	00	01	02	00	01
		1.750	3.750	02	01	02	02	01	02
		0.000	0.000	03	01	02	03	01	02
	54:18	0.000	-1.000	.11	05	.09	.11	05	09
		0.750	0.000	.12	04	.10	.12	04	10
		0.000	1.000	.14	06	.13	.14	06	.13
		0.000	3.750	18	09	.17	18	.10	.17
		0.500	3.750	16	08	.15	.16	08	.15
		1.000	3.750	.17	.08	.16	.17	.08	.16
		1.750	3.750	.12	05	.10	.12	.05	10
		0.000	0.000	.13	05	.10	13	.06	10
60:100	18 54	0.000	-1.000	05	02	05	05	02	05
		0.750	0.000	06	02	.05	06	02	05
		0.000	1.000	06	02	06	06	02	06
		0.000	3.750	09	04	09	09	04	09
		0.500	3.750	.10	03	09	.10	03	09
		1.000	3.750	08	03	08	08	03	08
		1.750	3.750	05	02	05	05	02	05
		0.000	0.000	04	01	04	04	01	04
	36 36	0.000	-1.000	06	01	04	.05	01	04
		0.750	0.000	04	01	03	04	01	03
		0.000	1.000	03	01	03	03	01	03
		0.000	3.750	08	03	08	08	03	08
		0.500	3.750	08	03	08	08	03	08
		1.000	3.750	05	01	05	05	01	05
		1.750	3.750	05	02	05	05	02	05
		0.000	0.000	03	01	02	03	01	02
	54 18	0.000	-1.000	09	03	09	09	03	09
		0.750	0.000	07	03	07	07	03	07
		0.000	1.000	08	03	08	08	03	08
		0.000	3.750	.11	05	10	11	05	10
		0.500	3.750	12	05	11	12	05	11
		1.000	3.750	.11	05	10	11	05	10
		1.750	3.750	08	03	08	08	03	08
		0.000	0.000	09	04	08	09	04	08

Table 4 Significant Region Sizes for Centered Intersection Point

Conditions					Procedure					
Samples	Variances	Distribution Shape		Region	Unprot. Johnson	Unprot. Potthoff	Unprot. Intersec	Protected Johnson	Protected Potthoff	Protected Intersec
N1:N2	V1:V2	Skew	Kurt	Size	Neyman	J-N	Pt. C. I.	Neyman	J-N	Pt. C. I.
25:25	18:54	0.000	-1.000	Mean	17.74	16.95	17.94	17.74	16.95	17.94
				StdDe	0.83	1.40	0.50	0.83	1.40	0.50
		0.750	0.000	Mean	17.90	17.20	18.06	17.90	17.20	18.06
				StdDe	0.64	1.15	0.44	0.64	1.15	0.44
		0.000	1.000	Mean	18.19	17.63	18.29	18.19	17.63	18.29
				StdDe	0.46	0.74	0.36	0.46	0.74	0.36
		0.000	3.750	Mean	18.36	17.87	18.44	18.36	17.87	18.44
				StdDe	0.44	0.64	0.36	0.44	0.64	0.36
		0.500	3.750	Mean	18.30	17.79	18.39	18.30	17.79	18.39
				StdDe	0.54	0.83	0.39	0.54	0.83	0.39
		1.000	3.750	Mean	18.26	17.73	18.36	18.26	17.73	18.35
				StdDe	0.68	0.92	0.42	0.68	0.90	0.62
		1.750	3.750	Mean	18.00	17.34	18.15	18.00	17.34	18.15
				StdDe	0.68	1.14	0.49	0.68	1.14	0.49
		0.000	0.000	Mean	16.71	15.29	17.38	16.71	15.32	17.24
				StdDe	2.59	3.80	1.20	2.70	3.77	2.24
	36:36	0.000	-1.000	Mean	17.58	16.72	17.84	17.58	16.72	17.83
				StdDe	1.10	1.68	0.63	1.10	1.68	0.60
		0.750	0.000	Mean	17.82	17.08	18.01	17.82	17.08	18.01
				StdDe	0.89	1.42	0.51	0.89	1.42	0.60
		0.000	1.000	Mean	18.25	17.72	18.34	18.25	17.72	18.34
				StdDe	0.42	0.62	0.34	0.42	0.62	0.34
		0.000	3.750	Mean	18.47	18.03	18.53	18.47	18.03	18.53
				StdDe	0.40	0.59	0.31	0.48	0.59	0.45
		0.500	3.750	Mean	18.45	17.99	18.51	18.45	17.99	18.51
				StdDe	0.37	0.53	0.32	0.37	0.53	0.32
		1.000	3.750	Mean	18.36	17.87	18.44	18.36	17.87	18.44
				StdDe	0.42	0.61	0.35	0.42	0.61	0.35
		1.750	3.750	Mean	17.93	17.21	18.11	17.92	17.21	18.10
				StdDe	0.98	1.59	0.62	1.03	1.59	0.81
		0.000	0.000	Mean	16.70	15.32	17.38	16.68	15.33	17.19
				StdDe	2.79	3.84	1.37	2.90	3.84	2.52
	54:18	0.000	-1.000	Mean	17.92	17.24	18.07	17.92	17.24	18.07
				StdDe	0.58	0.96	0.42	0.58	0.96	0.42
		0.750	0.000	Mean	17.98	17.33	18.12	17.98	17.33	18.12
				StdDe	0.65	1.06	0.44	0.71	1.06	0.55
		0.000	1.000	Mean	18.14	17.56	18.25	18.14	17.56	18.25
				StdDe	0.62	0.91	0.46	0.62	0.91	0.52
		0.000	3.750	Mean	18.21	17.65	18.32	18.21	17.65	18.32
				StdDe	0.67	0.99	0.46	0.67	0.99	0.56
		0.500	3.750	Mean	18.20	17.63	18.31	18.20	17.63	18.31
				StdDe	0.65	1.09	0.46	0.65	1.09	0.46
		1.000	3.750	Mean	18.17	17.60	18.29	18.17	17.60	18.28
				StdDe	0.67	1.02	0.46	0.71	1.02	0.56
		1.750	3.750	Mean	18.06	17.43	18.20	18.06	17.43	18.20
				StdDe	0.73	1.22	0.51	0.73	1.22	0.51
		0.000	0.000	Mean	16.64	15.24	17.33	16.62	15.28	17.15
				StdDe	2.88	3.97	1.60	3.05	3.93	2.64

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Table 4 continued. Significant Region Sizes for Centered Intersection Point

Conditions					Procedure					
Samples	Variances	Distribution Shape		Region	Unprot. Johnson	Unprot. Potthoff	Unprot. Intersec.	Protected Johnson	Protected Potthoff	Protected Intersec.
N1 N2	V1 V2	Skew	Kurt	Size	Neyman	J-N	Pt. C. I.	Neyman	J-N	Pt. C. I.
75 75	18 54	0.000	-1.000	Mean	18.87	18.57	18.89	18.87	18.57	18.89
				StdDe	0.14	0.18	0.13	0.14	0.18	0.13
		0.750	0.000	Mean	18.93	18.65	18.95	18.93	18.65	18.95
				StdDe	0.13	0.16	0.12	0.13	0.16	0.12
		0.000	1.000	Mean	19.05	18.80	19.06	19.05	18.80	19.06
				StdDe	0.10	0.13	0.10	0.10	0.13	0.10
		0.000	3.750	Mean	19.12	18.90	19.13	19.12	18.90	19.13
				StdDe	0.11	0.14	0.10	0.11	0.14	0.10
		0.500	3.750	Mean	19.11	18.88	19.12	19.11	18.88	19.12
				StdDe	0.11	0.14	0.11	0.11	0.14	0.11
		1.000	3.750	Mean	19.09	18.85	19.10	19.09	18.85	19.10
				StdDe	0.12	0.15	0.11	0.12	0.15	0.11
		1.750	3.750	Mean	18.97	18.71	18.99	18.97	18.71	18.99
				StdDe	0.15	0.20	0.14	0.15	0.20	0.14
		0.000	0.000	Mean	18.55	18.14	18.60	18.55	18.14	18.60
				StdDe	0.34	0.49	0.29	0.34	0.49	0.29
	36 36	0.000	-1.000	Mean	18.82	18.50	18.84	18.82	18.50	18.84
				StdDe	0.16	0.20	0.15	0.16	0.20	0.15
		0.750	0.000	Mean	18.90	18.61	18.92	18.90	18.61	18.92
				StdDe	0.14	0.18	0.13	0.14	0.18	0.13
		0.000	1.000	Mean	19.08	18.84	19.09	19.08	18.84	19.09
				StdDe	0.10	0.13	.09	0.10	0.13	.09
		0.000	3.750	Mean	19.18	18.97	19.19	19.18	18.97	19.19
				StdDe	.09	0.11	.09	.09	0.11	.09
		0.500	3.750	Mean	19.17	18.95	19.18	19.17	18.95	19.18
				StdDe	0.10	0.13	0.10	0.10	0.13	0.10
		1.000	3.750	Mean	19.13	18.91	19.14	19.13	18.91	19.14
				StdDe	0.11	0.14	0.10	0.11	0.14	0.10
		1.750	3.750	Mean	18.96	18.68	18.98	18.96	18.68	18.98
				StdDe	0.17	0.22	0.16	0.17	0.22	0.16
		0.000	0.000	Mean	18.57	18.17	18.61	18.57	18.17	18.61
				StdDe	0.36	0.51	0.30	0.36	0.51	0.30
	54 18	0.000	-1.000	Mean	18.93	18.65	18.95	18.93	18.65	18.95
				StdDe	0.11	0.14	0.11	0.11	0.14	0.11
		0.750	0.000	Mean	18.97	18.70	18.98	18.97	18.70	18.98
				StdDe	0.12	0.16	0.12	0.12	0.16	0.12
		0.000	1.000	Mean	19.03	18.78	19.04	19.03	18.78	19.04
				StdDe	0.12	0.15	0.11	0.12	0.15	0.11
		0.000	3.750	Mean	19.06	18.82	19.08	19.06	18.82	19.08
				StdDe	0.14	0.18	0.13	0.14	0.18	0.13
		0.500	3.750	Mean	19.06	18.81	19.07	19.06	18.81	19.07
				StdDe	0.14	0.18	0.13	0.14	0.18	0.13
		1.000	3.750	Mean	19.05	18.80	19.06	19.05	18.80	19.06
				StdDe	0.14	0.18	0.13	0.14	0.18	0.13
		1.750	3.750	Mean	18.99	18.72	19.00	18.99	18.72	19.00
				StdDe	0.15	0.19	0.14	0.15	0.19	0.14
		0.000	0.000	Mean	18.56	18.15	18.61	18.56	18.16	18.61
				StdDe	0.36	0.52	0.31	0.36	0.52	0.31

Table 4 continued. Significant Region Sizes for Centered Intersection Point

Conditions: Samples N1 N2	Variances V1 V2	Distribution Shape: Skew	Kurt	Region Size	Procedure: Unprot. Johnson Neyman	Unprot. Potthoff J-N	Unprot. Intersec. Pt. C. I.	Protected Johnson Neyman	Protected Potthoff J-N	Protected Intersec. Pt. C. I.
17 47	18.54	0.000	-1.000	Mean	17.62	16.75	17.86	17.61	16.75	17.84
				StdDe	0.85	1.55	0.50	0.97	1.56	0.75
		0.750	0.000	Mean	17.84	17.12	18.02	17.84	17.12	18.01
				StdDe	0.75	1.17	0.47	0.83	1.17	0.71
		0.000	1.000	Mean	18.24	17.69	18.33	18.24	17.69	18.33
				StdDe	0.48	0.80	0.35	0.48	0.80	0.35
		0.000	3.750	Mean	18.45	17.98	18.52	18.45	17.98	18.52
				StdDe	0.44	0.79	0.33	0.44	0.79	0.33
		0.500	3.750	Mean	18.42	17.94	18.49	18.42	17.95	18.49
				StdDe	0.47	0.78	0.36	0.45	0.77	0.36
		1.000	3.750	Mean	18.31	17.81	18.41	18.32	17.82	18.41
				StdDe	0.73	0.97	0.58	0.67	0.91	0.52
		1.750	3.750	Mean	17.93	17.22	18.11	17.92	17.22	18.10
				StdDe	0.91	1.55	0.53	0.99	1.55	0.76
		0.000	0.000	Mean	16.67	15.29	17.34	16.68	15.35	17.21
				StdDe	2.63	3.70	1.43	2.73	3.66	2.31
	36 36	0.000	-1.000	Mean	17.23	16.12	17.57	17.23	16.12	17.57
				StdDe	0.95	1.80	0.51	0.95	1.80	0.60
		0.750	0.000	Mean	17.52	16.63	17.77	17.52	16.63	17.77
				StdDe	0.77	1.27	0.45	0.77	1.27	0.55
		0.000	1.000	Mean	18.06	17.45	18.18	18.06	17.45	18.18
				StdDe	0.42	0.75	0.32	0.42	0.75	0.32
		0.000	3.750	Mean	18.35	17.86	18.43	18.35	17.86	18.43
				StdDe	0.50	0.65	0.30	0.50	0.65	0.45
		0.500	3.750	Mean	18.31	17.80	18.40	18.31	17.80	18.40
				StdDe	0.46	0.73	0.32	0.46	0.73	0.32
		1.000	3.750	Mean	18.21	17.66	18.31	18.21	17.66	18.31
				StdDe	0.45	0.72	0.35	0.45	0.72	0.35
		1.750	3.750	Mean	17.67	16.81	17.90	17.67	16.81	17.90
				StdDe	0.81	1.55	0.51	0.81	1.55	0.51
		0.000	0.000	Mean	16.21	14.39	17.11	16.18	14.42	16.90
				StdDe	2.77	4.20	1.23	2.96	4.18	2.45
	54 18	0.000	-1.000	Mean	18.05	17.42	18.20	18.05	17.42	18.19
				StdDe	0.77	1.25	0.48	0.82	1.25	0.58
		0.750	0.000	Mean	18.19	17.62	18.30	18.19	17.62	18.30
				StdDe	0.64	1.01	0.45	0.64	1.01	0.45
		0.000	1.000	Mean	18.42	17.94	18.50	18.42	17.95	18.50
				StdDe	0.61	0.91	0.45	0.60	0.90	0.42
		0.000	3.750	Mean	18.54	18.10	18.61	18.54	18.11	18.60
				StdDe	0.60	0.93	0.45	0.65	0.91	0.54
		0.500	3.750	Mean	18.48	18.02	18.56	18.49	18.03	18.56
				StdDe	0.86	1.29	0.67	0.93	1.24	0.82
		1.000	3.750	Mean	18.47	18.01	18.55	18.47	18.01	18.55
				StdDe	0.67	1.05	0.45	0.67	1.05	0.45
		1.750	3.750	Mean	18.24	17.70	18.36	18.25	17.71	18.35
				StdDe	0.92	1.25	0.61	0.89	1.22	0.76
		0.000	0.000	Mean	17.10	16.01	17.60	17.12	16.08	17.52
				StdDe	2.57	3.50	1.56	2.69	3.45	2.28

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Table 4 continued. Significant Region Sizes for Centered Intersection Point

Conditions					Procedure					
Samples	Variances	Distribution Shape		Region	Unprot.	Unprot.	Unprot.	Protected	Protected	Protected
N1 N2	V1 V2	Skew	Kurt	Size	Johnson Neyman	Potthoff J-N	Intersec Pt C I	Johnson Neyman	Potthoff J-N	Intersec. Pt C I
60 100	18 54	0.000	-1.000	Mean	18.84	18.54	18.87	18.84	18.54	18.87
				StdDe	0.14	0.18	0.13	0.14	0.18	0.13
		0.750	0.000	Mean	18.91	18.62	18.93	18.91	18.62	18.93
				StdDe	0.13	0.16	0.12	0.13	0.16	0.12
		0.000	1.000	Mean	19.06	18.82	19.08	19.06	18.82	19.08
				StdDe	0.10	0.13	0.10	0.10	0.13	0.10
		0.000	3.750	Mean	19.15	18.93	19.16	19.15	18.93	19.16
				StdDe	0.10	0.13	0.10	0.10	0.13	0.10
		0.500	3.750	Mean	19.14	18.92	19.15	19.14	18.92	19.15
				StdDe	0.11	0.14	0.10	0.11	0.14	0.10
		1.000	3.750	Mean	19.11	18.88	19.12	19.11	18.88	19.12
				StdDe	0.11	0.14	0.11	0.11	0.14	0.11
		1.750	3.750	Mean	18.97	18.70	18.98	18.97	18.70	18.98
				StdDe	0.15	0.19	0.14	0.15	0.19	0.14
		0.000	0.000	Mean	18.56	18.16	18.61	18.56	18.16	18.61
				StdDe	0.31	0.42	0.27	0.31	0.42	0.27
	36 36	0.000	-1.000	Mean	18.72	18.38	18.75	18.72	18.38	18.75
				StdDe	0.16	0.21	0.15	0.16	0.21	0.15
		0.750	0.000	Mean	18.82	18.51	18.85	18.82	18.51	18.85
				StdDe	0.14	0.18	0.13	0.14	0.18	0.13
		0.000	1.000	Mean	19.03	18.77	19.04	19.03	18.77	19.04
				StdDe	0.10	0.12	.09	0.10	0.12	.09
		0.000	3.750	Mean	19.16	18.94	19.17	19.16	18.94	19.17
				StdDe	.09	0.11	.08	.09	0.11	.08
		0.500	3.750	Mean	19.14	18.92	19.15	19.14	18.92	19.15
				StdDe	0.10	0.12	.09	0.10	0.12	.09
		1.000	3.750	Mean	19.09	18.86	19.10	19.09	18.86	19.10
				StdDe	0.11	0.14	0.10	0.11	0.14	0.10
		1.750	3.750	Mean	18.89	18.60	18.91	18.89	18.60	18.91
				StdDe	0.17	0.21	0.16	0.17	0.21	0.16
		0.000	0.000	Mean	18.48	18.05	18.53	18.48	18.05	18.53
				StdDe	0.33	0.45	0.29	0.33	0.45	0.29
	54 18	0.000	-1.000	Mean	18.98	18.71	19.00	18.98	18.71	19.00
				StdDe	0.11	0.15	0.11	0.11	0.15	0.11
		0.750	0.000	Mean	19.02	18.77	19.03	19.02	18.77	19.03
				StdDe	0.11	0.15	0.11	0.11	0.15	0.11
		0.000	1.000	Mean	19.10	18.87	19.11	19.10	18.87	19.11
				StdDe	0.11	0.14	0.11	0.11	0.14	0.11
		0.000	3.750	Mean	19.15	18.93	19.16	19.15	18.93	19.16
				StdDe	0.14	0.18	0.13	0.14	0.18	0.13
		0.500	3.750	Mean	19.14	18.92	19.15	19.14	18.92	19.15
				StdDe	0.13	0.17	0.13	0.13	0.17	0.13
		1.000	3.750	Mean	19.13	18.90	19.14	19.13	18.90	19.14
				StdDe	0.13	0.17	0.13	0.13	0.17	0.13
		1.750	3.750	Mean	19.05	18.80	19.06	19.05	18.80	19.06
				StdDe	0.14	0.19	0.14	0.14	0.19	0.14
		0.000	0.000	Mean	18.65	18.28	18.69	18.65	18.28	18.69
				StdDe	0.34	0.46	0.30	0.34	0.46	0.30

Table 5 Type I Error Rates for Noncentered Intersection Point

Conditions				Procedure					
Samples	Variances	Distribution Shape		Unprot. Johnson	Unprot. Potthoff	Unprot. Intersec.	Protected Johnson	Protected Potthoff	Protected Intersec.
N1 N2	V1 V2	Skew	Kurt	Neyman	J-N	Pt. C. I.	Neyman	J-N	Pt. C. I.
25 25	18 54	0.000	-1.000	04	01	07	04	01	07
		0.750	0.000	05	02	06	05	02	06
		0.000	1.000	05	02	06	05	02	06
		0.000	3.750	05	02	04	05	02	04
		0.500	3.750	04	02	04	04	02	04
		1.000	3.750	05	02	05	05	02	05
		1.750	3.750	05	02	06	06	02	06
		0.000	0.000	05	02	07	06	03	08
	36 36	0.000	-1.000	05	01	07	05	02	07
		0.750	0.000	05	02	07	05	02	07
		0.000	1.000	05	01	05	05	02	05
		0.000	3.750	06	02	05	06	02	05
		0.500	3.750	05	02	04	05	02	04
		1.000	3.750	05	02	04	05	02	04
		1.750	3.750	05	01	07	05	01	07
		0.000	0.000	05	02	07	07	04	09
	54 18	0.000	-1.000	05	02	07	05	02	07
		0.750	0.000	05	01	06	05	01	06
		0.000	1.000	05	02	05	05	02	05
		0.000	3.750	05	02	05	05	02	05
		0.500	3.750	05	01	05	05	01	05
		1.000	3.750	05	02	05	05	02	05
		1.750	3.750	05	02	06	05	02	06
		0.000	0.000	04	01	06	06	03	09
75 75	18 54	0.000	-1.000	05	01	06	05	01	06
		0.750	0.000	05	01	06	05	01	06
		0.000	1.000	06	02	05	06	02	05
		0.000	3.750	05	02	04	05	02	04
		0.500	3.750	06	02	05	06	02	05
		1.000	3.750	05	02	04	05	02	04
		1.750	3.750	05	01	06	05	01	06
		0.000	0.000	05	01	05	05	01	05
	36 36	0.000	-1.000	06	02	06	06	02	06
		0.750	0.000	05	02	06	05	02	06
		0.000	1.000	05	01	04	05	01	04
		0.000	3.750	06	02	05	06	02	05
		0.500	3.750	06	01	04	06	01	04
		1.000	3.750	04	02	04	04	02	04
		1.750	3.750	04	01	05	04	01	05
		0.000	0.000	05	02	06	05	02	06
	54 18	0.000	-1.000	06	02	07	06	02	07
		0.750	0.000	05	02	05	05	02	05
		0.000	1.000	05	01	05	05	01	05
		0.000	3.750	05	01	05	05	01	05
		0.500	3.750	05	01	04	05	01	04
		1.000	3.750	05	01	04	05	01	04
		1.750	3.750	05	01	05	05	01	05
		0.000	0.000	06	02	05	06	02	05

Table 5. Type I Error Rates for Noncentered Intersection Point

Conditions				Procedure					
Samples	Variances	Distribution Shape		Unprot. Johnson	Unprot. Potthoff	Unprot. Intersec.	Protected Johnson	Protected Potthoff	Protected Intersec.
N1:N2	V1:V2	Skew	Kurt	Neyman	J-N	Pt. C. I.	Neyman	J-N	Pt. C. I.
17:47	18:54	0.000	-1.000	.03	.01	.05	.03	.01	.05
		0.750	0.000	.04	.01	.06	.04	.01	.06
		0.000	1.000	.06	.02	.06	.06	.02	.06
		0.000	3.750	.08	.03	.07	.08	.03	.07
		0.500	3.750	.08	.03	.06	.08	.03	.06
		1.000	3.750	.07	.03	.06	.07	.03	.06
		1.750	3.750	.04	.02	.06	.04	.02	.06
		0.000	0.000	.05	.02	.06	.07	.04	.08
	36:36	0.000	-1.000	.01	.00	.02	.01	.00	.02
		0.750	0.000	.01	.00	.02	.01	.00	.02
		0.000	1.000	.02	.00	.02	.02	.00	.02
		0.000	3.750	.03	.00	.02	.03	.00	.02
		0.500	3.750	.03	.01	.03	.03	.01	.03
		1.000	3.750	.03	.01	.03	.03	.01	.03
		1.750	3.750	.02	.00	.04	.02	.00	.04
		0.000	0.000	.02	.00	.04	.03	.02	.06
	54:18	0.000	-1.000	.10	.04	.10	.10	.04	.10
		0.750	0.000	.11	.05	.09	.11	.05	.09
		0.000	1.000	.14	.07	.11	.14	.07	.11
		0.000	3.750	.14	.08	.13	.14	.08	.13
		0.500	3.750	.16	.08	.13	.16	.09	.14
		1.000	3.750	.14	.07	.12	.14	.07	.12
		1.750	3.750	.12	.05	.11	.12	.05	.11
		0.000	0.000	.12	.05	.11	.12	.07	.13
60:100	18:54	0.000	-1.000	.04	.01	.05	.04	.01	.05
		0.750	0.000	.04	.01	.05	.04	.01	.05
		0.000	1.000	.06	.02	.05	.06	.02	.05
		0.000	3.750	.07	.03	.06	.07	.03	.06
		0.500	3.750	.06	.02	.05	.06	.02	.05
		1.000	3.750	.06	.02	.05	.06	.02	.05
		1.750	3.750	.05	.01	.06	.05	.01	.06
		0.000	0.000	.05	.02	.05	.05	.02	.05
	36:36	0.000	-1.000	.02	.00	.03	.02	.00	.03
		0.750	0.000	.02	.00	.03	.02	.00	.03
		0.000	1.000	.03	.01	.02	.03	.01	.02
		0.000	3.750	.04	.01	.03	.04	.01	.03
		0.500	3.750	.04	.01	.03	.04	.01	.03
		1.000	3.750	.04	.01	.03	.04	.01	.03
		1.750	3.750	.03	.01	.04	.03	.01	.04
		0.000	0.000	.03	.01	.03	.03	.01	.03
	54:18	0.000	-1.000	.07	.03	.07	.07	.03	.07
		0.750	0.000	.07	.03	.06	.07	.03	.06
		0.000	1.000	.10	.04	.09	.10	.04	.09
		0.000	3.750	.10	.04	.10	.10	.04	.10
		0.500	3.750	.09	.04	.08	.09	.04	.08
		1.000	3.750	.09	.04	.08	.09	.04	.08
		1.750	3.750	.07	.02	.08	.07	.02	.08
		0.000	0.000	.08	.03	.09	.08	.03	.09

Table 6 Region Sizes for Noncentered Intersection Point

Conditions					Procedure					
Samples	Variances	Distribution Shape		Region	Unprot Johnson	Unprot Potthoff	Unprot Intersec	Protected Johnson	Protected Potthoff	Protected Intersec
N1 N2	V1 V2	Skew	Kurt	Size	Neyman	J-N	Pt C I	Neyman	J-N	Pt C I
25,25	18 54	0 000	-1 000	Mean	17.37	16.87	16 40	17.37	16.87	16.42
				StdDe	1 04	0 99	0 96	1.04	0.99	0 83
		0.750	0 000	Mean	17.49	17.01	16 62	17.49	17 01	16.64
				StdDe	0.99	0 94	0 92	0 99	0 94	0 81
		0 000	1 000	Mean	17.79	17 33	17 09	17 79	17 33	17 09
				StdDe	0 95	0 91	0 80	0 95	0 91	0 80
		0 000	3 750	Mean	18 00	17 56	17 38	18 00	17 56	17 38
				StdDe	0 90	0 88	0 83	0 90	0 88	0 83
		0 500	3 750	Mean	17 95	17 51	17 33	17 95	17 51	17 33
				StdDe	0 90	0 88	0 86	0 90	0 88	0 85
		1.000	3 750	Mean	17.90	17 45	17 25	17.90	17 45	17 25
				StdDe	0.94	0 92	0 89	0 94	0 92	0 89
		1 750	3.750	Mean	17 62	17 14	16 82	17 62	17 14	16 83
				StdDe	0 99	0 96	0 94	0 99	0 96	0 91
		0 000	0 000	Mean	17 13	16 58	15 45	17 15	16 61	15.75
				StdDe	1 25	1 20	2 15	1 27	1 25	1 54
	36 36	0 000	-1 000	Mean	17 30	16 79	16 23	17 30	16 79	16 25
				StdDe	1 10	1 04	1 01	1 10	1 05	0 94
		0.750	0 000	Mean	17 46	16 97	16 53	17.46	16 97	16 53
				StdDe	1 01	0 97	0 84	1 01	0 97	0 84
		0 000	1 000	Mean	17 84	17 39	17 18	17 84	17 39	17 18
				StdDe	0 92	0 89	0 80	0 92	0 89	0 79
		0 000	3 750	Mean	18 12	17 71	17 60	18 12	17 71	17 60
				StdDe	0 87	0 85	0 79	0 87	0 85	0 79
		0 500	3 750	Mean	18 12	17 69	17 56	18 12	17 69	17 56
				StdDe	0 86	0 83	0 79	0 86	0 83	0 79
		1 000	3 750	Mean	18 01	17 57	17 41	18 01	17 57	17 41
				StdDe	0 89	0 87	0 81	0 89	0 87	0 81
		1 750	3 750	Mean	17 61	17 13	16 76	17 61	17 13	16 76
				StdDe	0 96	0 92	0 95	0 96	0 92	0 90
		0 000	0 000	Mean	17.11	16.56	15.42	17.13	16 60	15.75
				StdDe	1 18	1 13	2 19	1 21	1 19	1 46
	54 18	0 000	-1 000	Mean	17 50	17 01	16 65	17 50	17 01	16 65
				StdDe	1 01	0 98	0 81	1 01	0 98	0 80
		0.750	0 000	Mean	17 60	17 11	16 78	17 60	17 11	16 78
				StdDe	0 99	0 95	0 83	0 99	0 95	0 83
		0 000	1 000	Mean	17 76	17 29	17 01	17 76	17 29	17 02
				StdDe	0 94	0 91	0 87	0 94	0 91	0 84
		0 000	3 750	Mean	17 90	17 45	17 19	17 90	17 45	17 21
				StdDe	0 97	0 95	1 04	0 97	0 95	0 93
		0 500	3 750	Mean	17 85	17 40	17 17	17 85	17 40	17 17
				StdDe	0 97	0 95	0 95	0 97	0 95	0 95
		1 000	3 750	Mean	17 86	17 40	17 13	17 86	17 40	17 13
				StdDe	1 00	0 98	1 03	1 00	0 98	1 03
		1 750	3 750	Mean	17 66	17 19	16 85	17 66	17 19	16 86
				StdDe	1 04	1 02	1 11	1 04	1 02	1 05
		0 000	0 000	Mean	17 13	16 58	15 53	17 18	16 65	15 84
				StdDe	1 33	1 30	2 23	1 37	1 36	1 65

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Table 6 continued Region Sizes for Noncentered Intersection Point

Conditions					Procedure					
Samples	Variances	Distribution Shape		Region	Unprot. Johnson	Unprot. Potthoff	Unprot. Intersec.	Protected Johnson	Protected Potthoff	Protected Intersec.
N1 N2	V1 V2	Skew	Kurt	Size	Neyman	J-N	Pt. C. I.	Neyman	J-N	Pt. C. I.
75 75	18 54	0 000	-1 000	Mean	18 33	17 99	18 05	18 33	17 99	18 05
				StdDe	0 69	0 67	0 62	0 69	0 67	0 62
		0 750	0 000	Mean	18 44	18 11	18 18	18 44	18 11	18 18
				StdDe	0 66	0 65	0 60	0 66	0 65	0 60
		0 000	1 000	Mean	18 67	18 37	18 46	18 67	18 37	18 46
				StdDe	0 61	0 60	0 58	0 61	0 60	0 58
		0 000	3 750	Mean	18 79	18 51	18 61	18 79	18 51	18 61
				StdDe	0 58	0 58	0 56	0 58	0 58	0 56
		0 500	3 750	Mean	18 81	18 52	18 62	18 81	18 52	18 62
				StdDe	0 59	0 59	0 57	0 59	0 59	0 57
		1 000	3 750	Mean	18 75	18 46	18 55	18 75	18 46	18 55
				StdDe	0 61	0 60	0 59	0 61	0 60	0 59
		1 750	3 750	Mean	18 49	18 17	18 24	18 49	18 17	18 24
				StdDe	0 66	0 64	0 61	0 66	0 64	0 61
		0 000	0 000	Mean	18 12	17 73	17 67	18 12	17 73	17 67
				StdDe	0 82	0 80	0 74	0 82	0 80	0 74
	36 36	0 000	-1 000	Mean	18 28	17 92	17 97	18 28	17 92	17 97
				StdDe	0 72	0 70	0 65	0 72	0 70	0 65
		0 750	0 000	Mean	18 38	18 05	18 11	18 38	18 05	18 11
				StdDe	0 67	0 65	0 61	0 67	0 65	0 61
		0 000	1 000	Mean	18 68	18 38	18 48	18 68	18 38	18 48
				StdDe	0 59	0 58	0 56	0 59	0 58	0 56
		0 000	3 750	Mean	18 90	18 64	18 75	18 90	18 64	18 75
				StdDe	0 55	0 55	0 53	0 55	0 55	0 53
		0 500	3 750	Mean	18 89	18 62	18 73	18 89	18 62	18 73
				StdDe	0 55	0 55	0 54	0 55	0 55	0 54
		1 000	3 750	Mean	18 81	18 52	18 63	18 81	18 52	18 63
				StdDe	0 57	0 56	0 54	0 57	0 56	0 54
		1 750	3 750	Mean	18 47	18 15	18 22	18 47	18 15	18 22
				StdDe	0 65	0 63	0 60	0 65	0 63	0 60
		0 000	0 000	Mean	18 12	17 72	17 66	18 12	17 72	17 66
				StdDe	0 81	0 78	0 71	0 81	0 78	0 71
	54 18	0 000	-1 000	Mean	18 39	18 06	18 14	18 39	18 06	18 14
				StdDe	0 66	0 65	0 61	0 66	0 65	0 61
		0 750	0 000	Mean	18 48	18 16	18 24	18 48	18 16	18 24
				StdDe	0 65	0 64	0 61	0 65	0 64	0 61
		0 000	1 000	Mean	18 59	18 29	18 37	18 59	18 29	18 37
				StdDe	0 61	0 60	0 58	0 61	0 60	0 58
		0 000	3 750	Mean	18 69	18 39	18 49	18 69	18 39	18 49
				StdDe	0 63	0 62	0 61	0 63	0 62	0 61
		0 500	3 750	Mean	18 71	18 41	18 50	18 71	18 41	18 50
				StdDe	0 62	0 61	0 60	0 62	0 61	0 60
		1 000	3 750	Mean	18 69	18 39	18 48	18 69	18 39	18 48
				StdDe	0 64	0 64	0 63	0 64	0 64	0 63
		1 750	3 750	Mean	18 52	18 20	18 29	18 52	18 20	18 29
				StdDe	0 66	0 65	0 62	0 66	0 65	0 62
		0 000	0 000	Mean	18 13	17 74	17 68	18 13	17 74	17 68
				StdDe	0 88	0 87	0 84	0 88	0 87	0 84

Table 6 continued. Region Sizes for Noncentered Intersection Point

Conditions					Procedure					
Samples N1:N2	Variances V1:V2	Distribution Shape Skew	Kurt	Region Size	Unprot. Johnson Neyman	Unprot. Potthoff J-N	Unprot. Intersec Pt. C. I.	Protected Johnson Neyman	Protected Potthoff J-N	Protected Intersec Pt. C. I.
17 47	18.54	0.000	-1.000	Mean	17 30	16.79	16 24	17 30	16.79	16 25
				StdDe	1 00	0 94	0 95	1 00	0 95	0 89
		0 750	0.000	Mean	17 43	16 93	16 46	17 43	16 94	16 48
				StdDe	1 00	0 95	1 00	1 00	0 95	0 89
		0 000	1 000	Mean	17 84	17 39	17 16	17 84	17 39	17 16
				StdDe	0 97	0 94	0 90	0 97	0 94	0 84
		0 000	3.750	Mean	18.10	17 69	17.56	18 10	17.69	17.56
				StdDe	0 93	0 92	0 86	0 93	0 92	0 86
		0.500	3.750	Mean	18 07	17.64	17 52	18 07	17.64	17.52
				StdDe	0 94	0 94	0 87	0 94	0 94	0 87
		1 000	3 750	Mean	17 99	17 55	17 37	17 99	17 55	17 38
				StdDe	0 98	0 97	0 98	0 98	0 97	0 90
		1 750	3 750	Mean	17 59	17 10	16 73	17 59	17 10	16 74
				StdDe	0 98	0 94	1 03	0 98	0 94	0 94
		0 000	0 000	Mean	17 16	16 59	15 38	17 18	16 63	15 72
				StdDe	1 23	1 18	2 29	1 26	1 25	1 53
	36 36	0 000	-1 000	Mean	16 96	16 42	15 63	16 96	16 42	15 64
				StdDe	0 94	0 87	0 97	0 94	0 87	0 93
		0 750	0.000	Mean	17 14	16 63	16 00	17 14	16 63	16 00
				StdDe	0 87	0 81	0 88	0 87	0 81	0 88
		0 000	1 000	Mean	17 64	17 17	16 83	17 64	17 17	16 83
				StdDe	0 84	0 80	0 77	0 84	0 80	0 77
		0 000	3 750	Mean	17 98	17 54	17 37	17 98	17 54	17 37
				StdDe	0 82	0 79	0 76	0 82	0 79	0 76
		0 500	3 750	Mean	17 95	17 51	17 31	17 95	17 51	17 31
				StdDe	0 79	0 76	0 75	0 79	0 76	0 75
		1 000	3 750	Mean	17 84	17 39	17 14	17 84	17 39	17 14
				StdDe	0 86	0 83	0 81	0 86	0 83	0 81
		1 750	3 750	Mean	17 29	16 79	16 24	17 29	16 79	16 25
				StdDe	0 86	0 81	0 97	0 86	0 81	0 93
		0 000	0 000	Mean	16 79	16 22	14 91	16 84	16 29	15 18
				StdDe	1 03	0 98	1 89	1 11	1 09	1 53
	54 18	0 000	-1 000	Mean	17 70	17 23	16 95	17 70	17 23	16 96
				StdDe	1 08	1 06	0 92	1 08	1 06	0 91
		0 750	0 000	Mean	17 85	17 39	17 18	17 85	17 39	17 19
				StdDe	1 06	1 06	0 94	1 06	1 06	0 93
		0 000	1 000	Mean	18 10	17 69	17 56	18 10	17 69	17 58
				StdDe	1 05	1 07	1 04	1 05	1 07	0 95
		0 000	3 750	Mean	18 25	17 85	17 78	18 25	17 85	17 80
				StdDe	1 01	1 04	1 07	1 01	1 04	0 97
		0 500	3 750	Mean	18 21	17 81	17 73	18 21	17 81	17 75
				StdDe	1 05	1 09	1 14	1 05	1 09	1 03
		1 000	3 750	Mean	18 20	17 79	17 70	18 20	17 79	17 71
				StdDe	1 06	1 09	1 06	1 06	1 09	1 05
		1 750	3 750	Mean	17 94	17 49	17 27	17 94	17 49	17 30
				StdDe	1 09	1 11	1 23	1 09	1 11	1 05
		0 000	0 000	Mean	17 51	16 98	16 09	17 53	17 02	16 43
				StdDe	1 34	1 34	2 37	1 35	1 38	1 51

Table 6 continued Region Sizes for Noncentered Intersection Point

Conditions Samples N1 N2	Variances V1 V2	Distribution Shape Skew	Kurt	Region Size	Procedure Unprot Johnson Neyman	Unprot Potthoff J-N	Unprot Intersec Pt C I	Protected Johnson Neyman	Protected Potthoff J-N	Protected Intersec Pt C I
60 100	18 54	0 000	-1 000	Mean	18 31	17 96	18 01	18 31	17 96	18 01
				StdDe	0 67	0 65	0 61	0 67	0 65	0 61
		0 750	0 000	Mean	18 41	18 08	18 14	18 41	18 08	18 14
				StdDe	0 65	0 63	0 60	0 65	0 63	0 60
		0 000	1 000	Mean	18 69	18 39	18 49	18 69	18 39	18 49
				StdDe	0 63	0 63	0 60	0 63	0 63	0 60
		0 000	3 750	Mean	18 85	18 57	18 68	18 85	18 57	18 68
				StdDe	0 59	0 59	0 57	0 59	0 59	0 57
		0 500	3 750	Mean	18 83	18 55	18 66	18 83	18 55	18 66
				StdDe	0 59	0 59	0 57	0 59	0 59	0 57
		1 000	3 750	Mean	18 78	18 49	18 59	18 78	18 49	18 59
				StdDe	0 62	0 62	0 60	0 62	0 62	0 60
		1 750	3 750	Mean	18 49	18 16	18 24	18 49	18 16	18 24
				StdDe	0 64	0 63	0 60	0 64	0 63	0 60
		0 000	0 000	Mean	18 14	17 74	17 68	18 14	17 74	17 68
				StdDe	0 82	0 80	0 73	0 82	0 80	0 73
	36 36	0 000	-1 000	Mean	18 12	17 76	17 76	18 12	17 76	17 76
				StdDe	0 66	0 63	0 59	0 66	0 63	0 59
		0 750	0 000	Mean	18 27	17 92	17 96	18 27	17 92	17 96
				StdDe	0 61	0 58	0 54	0 61	0 58	0 54
		0 000	1 000	Mean	18 63	18 32	18 40	18 63	18 32	18 40
				StdDe	0 57	0 55	0 53	0 57	0 55	0 53
		0 000	3 750	Mean	18 89	18 61	18 71	18 89	18 61	18 71
				StdDe	0 52	0 52	0 51	0 52	0 52	0 51
		0 500	3 750	Mean	18 83	18 54	18 65	18 83	18 54	18 65
				StdDe	0 54	0 53	0 52	0 54	0 53	0 52
		1 000	3 750	Mean	18 74	18 45	18 55	18 74	18 45	18 55
				StdDe	0 55	0 54	0 52	0 55	0 54	0 52
		1 750	3 750	Mean	18 35	18 02	18 07	18 35	18 02	18 07
				StdDe	0 61	0 59	0 58	0 61	0 59	0 58
		0 000	0 000	Mean	18 00	17 59	17 48	18 00	17 59	17 48
				StdDe	0 76	0 73	0 67	0 76	0 73	0 67
	54 18	0 000	-1 000	Mean	18 49	18 17	18 26	18 49	18 17	18 26
				StdDe	0 67	0 66	0 62	0 67	0 66	0 62
		0 750	0 000	Mean	18 55	18 24	18 34	18 55	18 24	18 34
				StdDe	0 67	0 67	0 63	0 67	0 67	0 63
		0 000	1 000	Mean	18 75	18 45	18 56	18 75	18 45	18 56
				StdDe	0 66	0 67	0 63	0 66	0 67	0 63
		0 000	3 750	Mean	18 83	18 55	18 66	18 83	18 55	18 66
				StdDe	0 65	0 66	0 63	0 65	0 66	0 63
		0 500	3 750	Mean	18 82	18 54	18 65	18 82	18 54	18 65
				StdDe	0 64	0 65	0 62	0 64	0 65	0 62
		1 000	3 750	Mean	18 78	18 50	18 61	18 78	18 50	18 61
				StdDe	0 66	0 67	0 64	0 66	0 67	0 64
		1 750	3 750	Mean	18 61	18 31	18 41	18 61	18 31	18 41
				StdDe	0 68	0 68	0 65	0 68	0 68	0 65
		0 000	0 000	Mean	18 24	17 86	17 85	18 24	17 86	17 85
				StdDe	0 90	0 90	0 84	0 90	0 90	0 84

Table 7. Type I Error Rates and Intersection Point Standard Errors for Various Sample Sizes and Slopes.

Type I Error Rates (alpha = .05)

	Slopes (+ and -) of the Two Groups			
Sample Sizes	0.1	0.3	0.5	0.7
25	.367	.190	.117	.088
75	.264	.105	.082	.065
150	.204	.085	.065	.077
250	.158	.074	.059	.049
500	.132	.053	.043	.056
1000	.101	.053	.046	.051
2000	.090	.058	.032	.047

Theoretical Standard Error (Substitutions into Formula 3)

	Slopes (+ and -) of the Two Groups			
Sample Sizes	0.1	0.3	0.5	0.7
25	30.14	10.05	6.03	4.31
75	17.17	5.72	3.43	2.45
150	12.10	4.03	2.42	1.73
250	9.36	3.12	1.87	1.34
500	6.61	2.20	1.32	.94
1000	4.67	1.56	.93	.67
2000	3.30	1.10	.66	.47

Observed Standard Error (of 1,000 Observed Intersection Points)

	Slopes (+ and -) of the Two Groups			
Sample Sizes	0.1	0.3	0.5	0.7
25	216.33	4254.67	232.11	34.89
75	141.75	276.86	43.01	3.31
150	826532.68	1184.44	3.32	1.99
250	452.92	5.79	2.40	1.43
500	150.05	2.40	1.43	.99
1000	83.11	1.72	.93	.68
2000	21.60	1.14	.65	.47

Average Estimated Standard Error (Across 1,000 Sample Estimates Using Formula 3)

	Slopes (+ and -) of the Two Groups			
Sample Sizes	0.1	0.3	0.5	0.7
25	212507.77	47025218.00	100251.75	539.10
75	55423.29	116920.87	1471.44	3.90
150	2944301000000.00	1377867.90	3.90	2.04
250	583595.62	10.73	2.43	1.47
500	46737.98	2.85	1.46	.99
1000	6343.37	1.75	.96	.68
2000	409.99	1.16	.68	.48